shorezones are restricted to the freshwater areas (Figure 3 D). Combination shorezones are those of diverse composition (including human modification) and are present throughout the NC coastal system.

Most estuarine shorelines in North Carolina are eroding in response to the interaction of storms and sea-level rise. However, previous studies indicate that shoreline erosion is extremely variable from site to site with significant ranges in erosion rates evident over short distances (Riggs, 2001; Riggs and Ames, 2003). The site with the highest average rate of recession in the Riggs and Ames (2003) study was the platform marsh at Point Peter Road (Pamlico Sound; see Figure 2 for site location) with an average recession rate of -7.5 feet per year in contrast to the lowest average recession rate of less than -1 foot per year along the bluff shoreline at Bay Hills (head of Pamlico River; see Figure 2 for site location). Shoreline change rates varied from 0 feet per year during periods of low storm activity to a high of -26 feet per year (erosion) along the sand bluffs at the north end of Roanoke Island during periods of high storm activity. Riggs and Ames (2003) determined that the average annual estuarine shoreline change rates for specific shoreline types ranged between +0.6 feet per year (accretion) for back-barrier beaches to -3.3 feet per year (erosion) for the mainland marshes.

From the Riggs and Ames (2003) data, several important patterns concerning average annual shoreline erosion rates for major shoreline types and estuarine regions are obvious. Mainland marsh and low sediment bank have the overall highest average rates of estuarine shoreline recession (-3.3 feet per year). They are also the most abundant shoreline types, constituting about 85% of the coastal system in northeastern North Carolina. Bluffs and high sediment banks, with their available sand, debris and vegetation, are less abundant (about 8%) and generally erode more slowly (-2.6 feet per year) compared to low sediment banks. Swamp forest shorelines are the least abundant (about 7%) and erode the slowest (-2.3 feet per year) due to their lack of elevation and low offshore gradients together with the role of trees in abating wave energy. Based upon this and other studies, several physical variables have been identified that act to shape/modify the shoreline as sea-level rises, producing alongshore variability in erosion rates (Table 2). The research presented below builds on this significant body of previous work.

Table 2. Physical variables shaping estuarine shorelines (modified from Riggs and Ames, 2003).

SHORELINE VARIABLES	DEFINITION	POTENTIAL FOR EROSION	
		LOW	HIGH
Fetch	Average distance of open water in front of shoreline	Short Fetch (<1000 feet)	Long Fetch (>1000 feet)
Offshore bottom character	Water depth and bottom slope in the nearshore area	Shallow, gradual slope (<3 feet)	Deep, steep slope (>3 feet)
Geometry of shoreline	Shape and regularity of shoreline (sinuosity)	Highly irregular or in a cove	Straight or on a headland
Height of sediment bank	Bank height at shoreline or immediately behind sand beach	High (>6 feet)	Low (<6 feet)
Composition of sediment bank	Composition and degree of cementation of bank sediments	Rock, tight clay	Uncemented sand, peat
Fringing vegetation	Type and abundance of vegetation (aquatic plants, marsh grasses, shrubs, trees, etc.) occurring in front of sediment bank	Very abundant, dense	Absent
Boat wakes	Proximity of property to, frequency and type of boat channel use	Absence of boats	Marinas, intracoastal waterway
Storms	Storms are the single most important factor determining specific erosional events	Depends on type, intensity, duration and frequency of storms	